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The Utilization of Low Density Timber As Structural Materials

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Current State and Future Chances of Low Density Timber Utilization



BY

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Introduction

Compared with other materials for structural application, timber is still an important material. Many advantages can be taken from wood as structural timber for construction material since it is renewable, machinable, and fancy. Mostly problem encountered working with timber is the high variation of properties including mechanical properties.

Some requirements for timber structure are as follow: strong, convenient and safe; durable and long age; economical for most people; and having esthetic values (good appearance and architectural form).

There are some notices regarding utilization of timber in Indonesia (1). Forest conditions (as sources of timber), (2). Shortage of raw material; and (3). Application of technology. The utilization of timber nowadays are limited to commercial species such as Keruing, Kamper, Merbau, Kempas, Jati, etc. and from a mixed hardwood species called as "Borneo" timber. Those species have relatively high strength grade (high density). In the near future, there will be a change of paradigm with regard to the use of timber from well-known species with high strength grade (high density) to species with low strength grade (low density), especially of fast growing species (mangium, sengon, manii, gmelina). These changes occurred due to forest degradation. Attempts need to be done to improve the wood properties of low density species. The advantages of fast growing species are faster growth, silviculture technique are well-known and more economical (cost-effective).

Forest Conditions

The major problem of the continuous of wood supply is illegal logging. This has significantly disturbed not only the current supply-demand of wood but also ecological function of forest. The total annual allowable cut in 2002 was 17.2 million m^3 (Table 1). However, demand of wood is much higher amounting to more than 60 million m^3 per year. Illegal logging activities have led to forest degradation which is recorded to become almost 3.8 million ha per year. The most forest degradation

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occurred in natural forest (production forest) which is the main source of most commercial timber.

Table 1. Wood supply from the legal sources (m^3)

Sources	1995	1996	1997	1998	1999	2000
Production forest (HPH)	17.012..949	15.595.766	16.224.228	11.867.27 4	8.599.105	7.661.219
Conversion forest (IPK)	5.845.475	7.232.482	9.524.572	7.249.878	6.239.278	4.643.993
Community forest	149.023	603.151	1.213.928	719.074	957.056	232.134
State forest in Java (Perhutani)	1.795.630	1.911.757	1.604.034	1.718.561	1.890.900	897.615
Plantation Forest (HTI)	514.692	474.268	425.893	480.210	4.844.493	3.779.828
Total	**25,317,77**	**25,817,427**	**28,992,657**	**22,034, 99**	**22.530.8373**	**17,214,789**

Source: Potret Keadaan Hutan Indonesia, 2001

Nowadays, timber supplies are dominated by commercial wood of certain species (Balau, Keruing, Meranti, Merbau, Kempas, etc.) and a mixed species ("Borneo") originating either from natural forest or forest plantation (Jati, Pinus, Agathis). Some and mostly fast growing tree species has become substitute of that species. The substitute species are mostly mangium (*Acacia mangium*), sengon (*Paraserianthes falcataria*), manii ((*Maesopsis eminii*), gmelina (Gmelina arborea). The most drawbacks of the species are low density ($\leq$ 0.6 g/cm3) and low durability (Table 2). These properties generally will influence the mechanical properties, so that effort to improve these properties and quality are required.

Table 2. Strength and Durability Class Based on Indonesian Timber Construction Code (PKKI-1961)

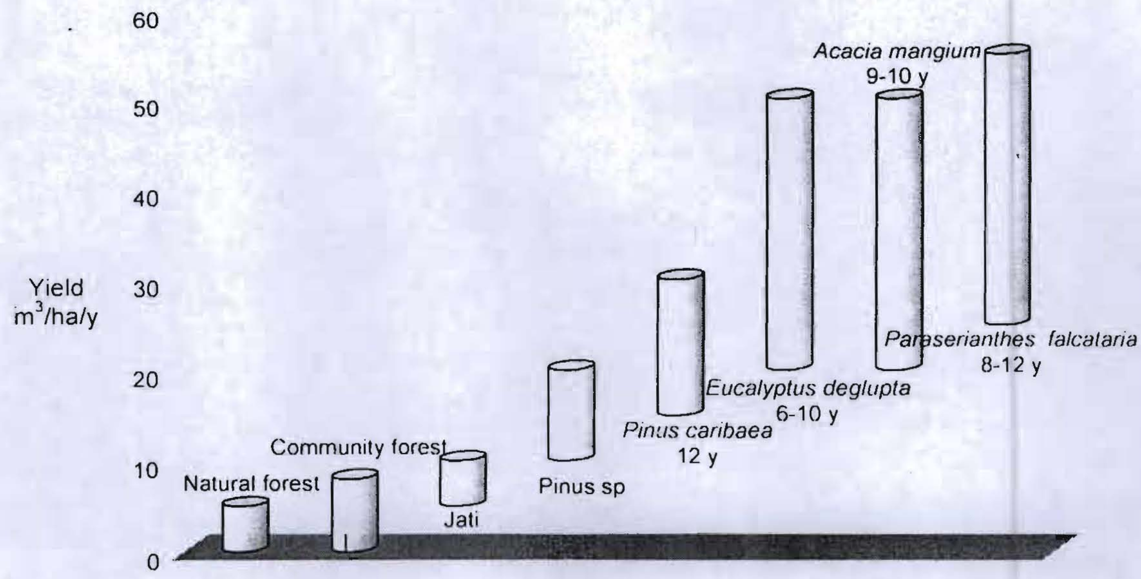
Species	Density	Wood strength class	Wood durability class
Balau	0.98	I-II	I-II
Kempas	0.95	I	III
Merbau	0.80	I-II	I-II
Keruing	0.79	I-II	III-IV
Meranti	0.55	II-IV	III-IV
Jati	0.70	II	I
Pinus	0.59	III	IV
Agathis	0.47	III	IV
Mangium	0.60	III	III
Manii	0.40	III	IV
Gmelina	0.40	III	IV
Sengon	0.33	IV-V	IV-V

Since timber supply from forest plantation (about 6 million m^3 per year) are not sufficient, establishment of plantation to particular fast growing species such as mangium may become good prospect for sustainable timber supply. However, this requires full commitment from all stakeholders to be successful.

Shortage of Raw Materials

Shortage of raw materials means limited commercial wood supply which is usually originated from natural forest. To overcome this problem, attempts need to be done in order to find out other promising species which has not only great potential in supply but also has good properties especially in strength properties, etc.

The production profile of forest (Figure 1) shows that there are some prospects from plantation forest and community forest based on yield per year.



Some species which are categorized as fast growing (mangium and sengon) have annual increment more than 25 m^3/ha which is much higher than Jati or other species. It means that some species has a good prospect to replace current commercial wood supply. In comparison to fast growing species which have relatively short rotation, 8-10 years old, Jati has rotation 25 years old. This condition shows that how those kinds of species can be used as alternative to solve problem of wood continues supply.

Actually, timber as structural material lay on wood strength I and II (Indonesian Timber Construction Code, 1961). Wood strength class III sometimes can be considered as structural materials. An important case study is for mangium which has density about 0.42-0.56 g/cm^3 but its mechanical properties is comparable with others fast growing species even with Meranti (Table 3).

Table 3. Technical comparison properties of some species

Properties	*A. mangium*	*M. eminii*	*G. arborea*	*A. chinensis*	Rubber wood	Nyatoh	Light Red Meranti
Density (g/cm3)	0.42-0.56	0.48-0.62	0.35-0.42	0.22-0.38	0.55-0.65	0.55-1.0	0.52-0.60
Bending St							
MOR (Mpa)	97-102	50-60	57-62	45-52	58-66	75-82	63-75
MOE (Mpa)	11,600	12,000	9,200	6,900	9,200	12,200	10,200
Shrinkage							
Radial (%)	3.4	3.8	3.0	3.0	3.0	3.0	2.7
Tangent (%)	6.5	6.7	6.3	5.5	7.0	7.0	7.5
Kiln Drying	Slow	Easy	Moderate	Easy	Slow	Easy	Easy
Work prop							
Sawing	Good	Good	Good	Fiber surf	Good	Good	Good
Moldings	Good	Good	Good	Tears	Good	Good	Good
Peeling	Good	Good	Good	Good	Good	Good	Good
Turning	Good	Good	Good	Tears	Good	Good	Good
Sanding	Good	Good	Good	Good	Good	Good	Good

Souroce: Djojosoebroto (2003) and Dharmasepfianti (1991)

Other species which have good prospect is manii (*Maesopsis eminii*). Some positive properties are easy in preservative treatment, good appearance, and known as light construction materials.

Application Technology

As mentioned before, the main problem encountered if we are using timber originated from plantation of fast growing species is low density and rather small diameter log. Therefore, timber from that species is not good for structural uses. However, some studies have been done to overcome this problem. Timber lamination is one of the solutions to increase their utilization scheme. Other solutions from those are applications of stress grading for structural timber and improvement of silviculture techniques.

Indonesian standard of stress grading provides timber stress classification. In this classification, PKKI-1961, SKI C-bo-10-1987 and SNI 2000 accommodate requirements on stress grading of Indonesian timber. However, application and socialization to the users of those standards are still needed.

To obtain high quality of stands, improvement of silviculture techniques become good solution. In case of *A mangium*, pruning and singling in right time will help to reduce of knots as well as girdling before felled trees will prevent checks in timber.

Conclusion

Timber for structural material has high requirements in strength. The paradigm of wood utilization or wood sources has to be changed from natural forest to plantation forest. Plantation forest as promising wood source should have short rotation (fast growing) with good wood properties. Examples of some promising fast growing species with good properties in strength are *Acacia mangium* and *Maesopsis eminii*. Improving the properties in strength for others species are needed to introduce timber from low density as structural material such as wood composite conversion, application of stress grading and improving silviculture techniques.

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(1) (2) (3)
Prosale, Purwanto, ~~Kobades~~ Erwin / fowit wadaz !
↳ Ashiyoso !

(1) ½ = Shear load ? — konstru
(2) ½ − low density → sengon) after zaun
bacoin deflection →
— kandos. m. lentig

(3) ½ − SS wood grain → OK ?
/ hardness → sengon. → Africa →
Acacia →
↳ ultra sonic. 1985 oibalam !

kayu → preservation ∑ → sustain able.

Asmu Sembing
(4) ✓ Sembr oyp air → kayu (1) → - pentr air) tanah lembab !
- fondasi

cemende! (2) → pentr 2 air ϕ 15 2/2 20 cm
(3) Kayu Kelapa ↳ Dr Isnae Yuniar
Jate Unmul.

Bota
(5) ✓ culture of the people → Gloria Galosla.
segitabang ! Rasa sayang !
mon telin !